Clean Air Act 112(r) Risk Management Program (RMP) EPCRA

# CHEMICAL EMERGENCY PREVENTION & PLANNING Newsletter

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CHEMICAL EMERGENCY PREVENTION & PLANNING *Newsletter*
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**This issue features:**

### OPERATING PROCEDURES

**The Risk Management Program (RMP) of the EPA requires the facility to develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information....(40 CFR 68.69.)**

# Know Your Lock-out and Tag-out Safety Procedures

Hazardous energy comes in many forms. Electrical energy can cause electrocution and burns, provide ignition to flammable atmospheres, and activate mechanical equipment. Steam can cause burns or initiate hazardous reactions. Nitrogen can cause asphyxiation. Chemical flow can cause uncontrolled reaction and injury. When a piece of equipment is being worked on, all sources of hazardous energy must be securely and positively locked out until the equipment is operational.



Untold numbers of major process safety incidents and individual injuries have been caused by failure of LOTO. A prime example is the Bhopal catastrophe, one of the worst incidents ever to have occurred, which was caused in part by the failure of LOTO.

It is better to learn from the mistakes of others rather than to learn by painful, personal experience. The purpose of this featured article is to share information with you, to help you lead the implementation or improvement of LOTO

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in your company. A brief overview of LOTO procedures and tools are provided, as are references to more detailed resources.

## Basics of LOTO

Summarized here are the bare essentials of a good LOTO program. To have a good LOTO program:

**DO:**

1. Have a corporate-wide LOTO policy that is mandatory at all sites.

2 Train affected employees in proper LOTO procedures, and retrain regularly.

3 Assign authorized employees to ensure that LOTO procedures are faithfully and thoroughly followed.

4 Identify all sources of hazardous energy potentially impacting a piece of equipment and lock out all sources.

5 Make sure each person working on a piece of equipment applies his personal lock to the lockout device, as shown in the figure.

6 Apply a tag to the lockout point using a fastener that cannot be easily or accidentally removed. Use a tag that is not easily torn or defaced.


7 Make sure that any stored energy has been released. This includes electrical capacitance, pressure, residual fluids and hazardous atmospheres, and pent up mechanical and potential energy.

8 When maintenance activity extends beyond the current shift, replace the personal locks of the leaving shift with the personal locks of the arriving shift. The leaving shift should make sure the arriving shift understands the maintenance process and the hazards.

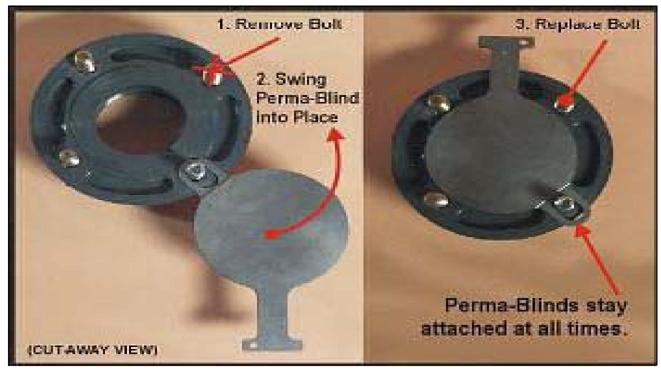
9 Once the locks and tags are place, try to operate the equipment to ensure that no lock-outs have been missed.

10 Locks should not be removed until the maintenance workers and the authorizing employee are satisfied that the equipment is ready to be operated safely.

**DO NOT:**

1. Remove another worker's lock unless the worker is completely unavailable and then only remove the lock after a qualified supervisor has verified that it is safe to remove the lock and authorized the removal.

2 Assume that a closing and locking a valve is sufficient to prevent flow. The pipe must also be blinded. A cut-away view of one blind arrangement is shown in the figure below.




3 Assume that a piece of equipment has only one electrical source. Often, equipment has two or more – all must be locked out.

## Learning from CASE HISTORIES

The case histories presented here come from companies with good LOTO programs. They are offered to give you a better understanding of the full range of hazardous energy sources and situations where LOTO is important.

### Lock-out, Tag-out, and Try-out

Pay particular attention to the last step in locking out equipment – verify that the residual and stored energy has been released. Remember – Lock Out, Tag Out, and then Try Out. Make sure that you're not surprised by residual energy, as happened in this case:

*Workers were attempting to clear a plugged line. The LOTO permit was authorized and locks placed as per*

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*procedure. Unfortunately, the workers did not verify that all hazardous energy was removed. The residual pressure from blowing out the line remained. As workers opened a flange just below the plug, material was blown out, burning personnel in the immediate* area.

## Take Care When Troubleshooting

Sometimes LOTO might seem inconvenient, for example if you need to have parts of a machine or process energized for troubleshooting. In such cases, lock out the process completely, determine which lock-outs need to be removed to do the energized tests, evaluate the potential hazards carefully, and take the appropriate precautions. Only then remove the lock-outs. As soon as the need for the equipment to be energized has passed, the process should be locked out again. Here's what can happen if you forget that last important step:

*A worker was trying to clear a blocked pipe. The LOTO permit was authorized, and all of the required locks were placed according to procedure. The worker opened several valves in an attempt to try to blow it free. This did not work, so he re-closed the valves and reinstalled the lock-outs......except that he missed the valve on the pressurizing line. When the worker opened a flange below the plugged valve, material was blown out, burning the worker.*

## Lock-out and Tag-out Equipment that is Out-of-service

LOTO is particularly important when removing defective equipment from service. Lock out and tag out defective and unused equipment until it can be removed or replaced. If you fail to do this, you could repeat the following accident:

*One pump of a two-parallel arrangement was out of service but not locked out. Workers, switched to the out of service pump as part of a routine rotation. This resulted in a major process upset costing millions of dollars. Luckily, no one was injured.*

# LOTO References

The following references contain regulatory requirements. While different regulations may apply to your site, the OSHA standard and supporting documentation serves as a good reference to LOTO.

1. OSHA Standard 29 CFR 1910.147:
   http://www.osha.gov

2. OSHA Training for Small Businesses:
   http://www.osha.gov/SLTC/smallbusiness/sec11.html

3. NIOSH Guidelines for Lock-out Tag-out:
   http://www.cdc.gov/niosh/83-125.html

4. CCPS, "Guidelines for Process Safety Documentation" pp 307-309, American Institute of Chemical Engineers 1995:
   http://www.aiche.org/pubcat, publication G-27

5. Oklahoma State University Lock-out Tag-out Program:
   http://www.pp.okstate.edu/ehs/manuals/Lock-tag.htm

## Lock-out Requires a Lock

Finally, never rely on an interlock for LOTO. Make sure you positively lock out all the sources of hazardous energy. This operator wished he'd done it right:

*An operator needed to clean a mixer. The mixer had an interlock limit switch that prevented the mixer from operating when the lid was up. For protection, the operator propped the lid up and entered (we assume he performed the appropriate confined space entry procedure, but that is a lesson for another day). When the mixer was clean, the operator started to climb back out. As he reached up, his hand touched the lid. This was just enough to clear the 'lid is up' limit switch and deactivate the interlock. Since he had not locked out the power, the motor started. The motion of the mixer caused the operator to fall back inside. When he fell, the lid returned to full-open and the limit switch interlocked the mixer mechanism. However, the mixer made a number of complete revolutions – badly injuring the operator – before coming to a stop.*

(Reference: CCPS Safety Alert)

# Removal of Hazardous Material from Piping Systems

Chemical and refinery facility personnel open piping and equipment to perform routine maintenance, add/replace components, or modify pipe routing. The piping may contain hazardous material, such as flammable hydrocarbons, toxic chemicals, or thermally reactive chemicals. Safe work practices dictate the removal or mechanical isolation of hazardous material from piping and equipment (e.g., using valves or blind flanges) before commencing work.

This article identifies specific tasks that facilities should include in all work activities involving piping or equipment opening to ensure the complete removal of hazardous material. In addition, guidance is provided on implementing generic (plant-wide) procedures for non-routine work activities.

### Sample Incident: PEROXIDE EXPLOSION and FLASH FIRE

The Chemical Safety and Hazard Investigation Board (CSB) investigated an explosion and fire at a Huntsman Petrochemical Corporation facility in Port Neches, Texas. During a steam purge for a piping modification that required line opening and hot work (i.e., cutting and welding), a peroxide/alcohol mixture was heated above its thermal decomposition temperature. The mixture was trapped in a low point (U-loop) along a 900-foot-long, 6-inch process pipe. The resulting explosion and fire seriously injured two employees.

Plant personnel incorrectly believed that a nitrogen gas purge preceding the steam purge had removed all liquid from the pipe. However, an unknown quantity of a thermally reactive peroxide/alcohol mixture remained in an unidentified low-point trap in the pipe. As the steam heated the trapped peroxide, it exothermically decomposed and overpressurized the pipe, causing it to rupture (Figures 1 and 2).

*Figure 2: Ruptured pipe/valve and fire damage*

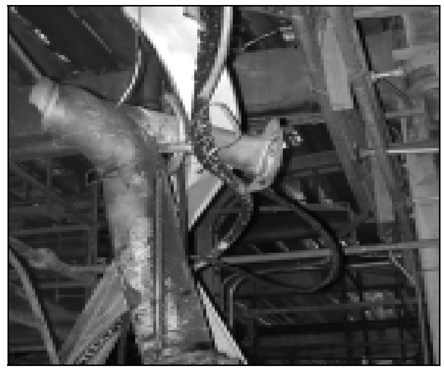

*Figure 2: Piping tangled in damaged overhead electrical conduits*

- **Incomplete Removal of Hazardous Mixture**

  Plant personnel were aware of the hazards associated with leaving peroxide in a closed piping system. However, the procedural steps for the nitrogen gas purge were ineffective in removing all of the peroxide/alcohol mixture from the low point sections of the pipe. Nitrogen purging was intended to clear thermally reactive liquids from the line prior to steam purging to remove all traces of flammable material. Steam purging was a prerequisite to performing hot work on any piping or equipment.

- **Inadequate Verification of Pipe Routing**

  A comprehensive review of the asbuilt drawings, combined with a walkdown of the entire peroxide/alcohol transfer pipe would have likely identified the low-point trap. As in most large chemical manufacturing facilities, many miles of piping were routed throughout overhead pipe racks (Figure 3).

*Figure 3: Piping and conduits in congested overhead pipe rack*

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There is a high probability that some low points will be overlooked unless a pipe walkdown focuses on identifying both low points and installed drains.

- **Unsafe Heating of Thermally-Sensitive Chemicals**

Using the generic steam purging procedure on the peroxide/alcohol pipe created an unanticipated hazard. The steam temperature exceeded 380ºF, which is significantly above the decomposition temperature of the peroxide.

- **Inadequate Hazards Review of Procedure Revision**

Purging with inert gas or steam does not necessarily remove trapped liquid. The purging procedure:

- o Failed to address the importance of identifying low points in the piping.
- o Failed to require the use of low point drains to remove trapped hazardous liquids.

The inert gas purging procedure was applied to process pipes containing thermally unstable liquids without adequately considering the hazards if these liquids remained in the pipe during the steam purge.

## LESSONS LEARNED

### ❖ Non-routine Pipe and Equipment Opening

Opening chemical process piping and equipment can be extremely hazardous. It should never be considered routine work.

Facilities handling hazardous chemicals should:

- ✓ Perform a complete walkdown of all piping and components between the isolation devices. Update as-built drawings as necessary.
- ✓ Use as-built drawings of the affected piping to identify all branch connections, isolation valves, low-point drains, and high-point vents.
- ✓ Prepare a specific written procedure for removing, flushing, and purging hazardous material from the system. Consider the consequences if flushing liquid remains in the system after the work is completed.

### ❖ Unit-Specific Procedures

Unit-specific procedures should be used to ensure the safe conduct of non-routine activities, such as steam purging of process lines that handle thermally unstable liquids. Facilities should:

- ✓ Review planned steps against unit-specific hazards.
- ✓ Update unit-specific procedures as necessary to address unique characteristics of the activity, especially when modifications are involved.

If a modification activity includes the use of generic safety procedures, clearly identify applicable constraints (e.g., specify additional inspection steps to verify removal of all energy sources, including thermally reactive chemicals).

(Reference: CSB Safety Publication)

# RMP Requirements for *Operating Procedures*

The Risk Management Program (RMP) of the EPA requires the facility to develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information….(40 CFR 68.69.)

The chart below briefly summarizes the RMP requirements for operating procedures.

| RMP Process Safety Information Chart | | | |
|---|---|---|---|
| **Steps for each operating phase** | **Operating limits** | **Safety & health considerations** | **Safety systems & their functions** |
| ✓ Initial startup<br>✓ Normal operations<br>✓ Temporary operations<br>✓ Emergency shutdown<br>✓ Emergency operations<br>✓ Normal shutdown<br>✓ Startup following a turnaround or emergency shutdown<br>✓ Lockout/tagout<br>✓ Confined space entry<br>✓ Opening process equipment or piping<br>✓ Entrance into the facility | ✓ Consequences of deviations<br>✓ Steps to avoid, correct deviations | ✓ Chemical properties & hazards<br>✓ Precautions for preventing chemical exposure<br>✓ Control measures for exposure<br>✓ QC for raw materials and chemical inventory<br>✓ Special or unique hazards | ✓ Address whatever is applicable |

# Confined Space Incidents and Lessons Learned

Serious accidents have occurred and will continue to occur, while work is being done inside confined spaces. The chief risks are those associated with toxic and/or flammable gases, fumes and vapor. Neglect or ignorance of the necessary precautions can lead very easily to tragic results. Employees assigned to work in confined spaces are not the only people at risk. A National Institute for Occupational Safety and health (NIOSH) study suggests that more than half of those killed in confined spaces were rescuers. In some cases, as many as four would-be rescuers were killed in a single accident.

## Fatal Facts

**CASE: Electrical hazard and flammable vapors**

### One painter died, another sufferred severe burns from flash fire explosion

A 41-year-old painter entered the top opening of a 1,300-gallon tank in order to paint the inside with flammable epoxy paint. To provide interior lighting, a co-worker placed a 500-watt, non-explosion proof halogen lamp close to the opening. The co-worker sat on top of the tank to observe while the painter sprayed the bottom and sides of the tank. As he painted, the spray gun nozzle hit the lamp, broke the sealed beam, ignited the epoxy vapor, and caused a flash fire explosion. Over 40 percent of the painter's body was burned, and he died five days later. His co worker suffered a broken arm and burns to his face and neck. The company did not have a formal safety program and no job hazard analysis had ever been done.

**CASE: Oxygen deficiency and cyanide gas**

### Workers killed by cyanide gas; employer charged with negligence

In Oakland, California, an employee from an electroplating company was overcome by cyanide gas while cleaning the interior of a wastewater treatment tank containing toxic acids and cyanide sludge. When a second employee entered the tank to rescue the co-worker, he was overcome by the fumes and died. Several other employees were hospitalized as a result of their involvement in the rescue and cleanup operations. Criminal charges were filed through the District Attorney's Office and a $741,000 fine was assessed. The employer was cited for a number of safety violations, including failing to:

(1) prevent unauthorized entry into a confined space;
(2) develop and implement a confined space program;
(3) specify acceptable entry conditions;
(4) label tanks to indicate their contents; and
(5) test for oxygen deficiency.

**CASE: Oxygen deficiency and toxic vapors**

### Worker died of asphyxia in toxic vapor-filled gasoline delivery manhole

In El Monte, California, the body of a worker was found in a gasoline delivery manhole measuring 36 inches in diameter by six feet deep. This was a permit-required confined space. The victim had been working in the manhole without any protection and asphyxiated after inhaling gasoline vapors. After an investigation, the employer was cited for failing to conduct or provide:

(1) a written permit-required confined space program;
(2) a hazard evaluation;
(3) adequate training; and
(4) protective equipment or clothing.

**Other Incidents:**

- *Two workers on top of a digester that had been drained opened the hatch and lowered an extension cable with an exposed 200 watt light bulb to check the sludge level. The light bulb broke and exploded the methane in the digester. Both men died instantly.*
- *An engineer entered an inspection chamber to test for seepage and collapsed. Three work colleagues attempted a rescue and as each entered the chamber, collapsed also. All four men died.*
- *A worker entered a chemical degreaser to clean the bottom. He collapsed. Two colleagues entered to rescue him. All three died.*

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- *Employees and visiting dignitaries entered an underground valve house of a water transfer system. As part of a presentation, water was to be pumped over a regulating weir into the river. Shortly after pumping commenced, there was an intense flash and followed by an explosion. The explosion was caused by an accumulation of methane and air which was pushed into the valve room when pumping commenced. Sixteen people were killed and 28 others were injured in the explosion.*

- *A city worker was removing an inspection plate from a sewer line in a deep pump station when the plate blew off and sewage entered the room. Two colleagues and a policeman attempted to rescue him from the sludge filled room. All four died.*

- *A sewer worker collapsed at the bottom of 3-meter manhole. Two workmates entered to rescue him and were themselves overcome. By the time they were extracted from the manhole by rescue services, the man was dead. His would-be rescuers died two days later. A fourth man at the entrance of the manhole suffered shock and fume inhalation.*

- *A worker cleaning the bottom of a septic tank collapsed. Two colleagues who went to rescue him also collapsed. All three died.*

## Confined Space

The Occupational Safety and Health Administration (OSHA) in 1926.21(5)(ii) defines **"Confined Space** as any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere". In addition, OSHA in 1910.146 uses the term **"permit-required confined space"** to describe those spaces that both meet the definition of "confined space" and pose health or safety hazards.

## Controlling the Hazard

To ensure worker safety, employers must have a written confined-space entry program, including permit and rescue procedures, before allowing employees to enter confined spaces. Employees must have suitable training before participating in confined-space entry or rescue procedures. Lockout procedures need to be implemented where appropriate to control energy sources and gas and liquid lines.

(References: OSHA; Confined Space Training 2006, Technical Learning College)

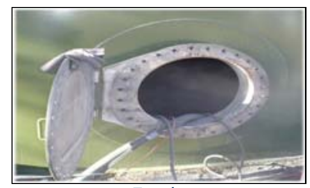
## Examples of "PERMIT-REQUIRED CONFINED SPACES"



*Manhole*


*Vessel*


*Pipe opened on one end only*


*Tank*


*Railroad Tanker*


*Sump*

### Confined Space

## Questions & Answers

- **How do toxic or flammable atmospheres develop in confined spaces?**

  - The work performed within the confined space (such as welding, degreasing, painting, or sanding) may produce toxic or flammable atmospheres.

  - Toxic gases and flammable vapors from adjacent areas can migrate to and collect in the confined space.

  - Vapors may be released from the sludges on the bottom or scales on walls of emptied confined

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spaces, such as storage tanks, that previously contained flammable or toxic chemicals. Vapor release may be accelerated by wall scraping and sludge removal from confined spaces.

- Remember, atmospheric changes may occur due to the work procedure, the product stored, or a nearby gas line leak. The atmosphere may be safe upon entry, but can change very quickly.

### ▪ When are vapors or gases combustible or explosive?

- Gases or vapors can only be combustible or explosive between their lower explosive limit (LEL) and upper explosive limit (UEL). This is called the ***flammable range.***

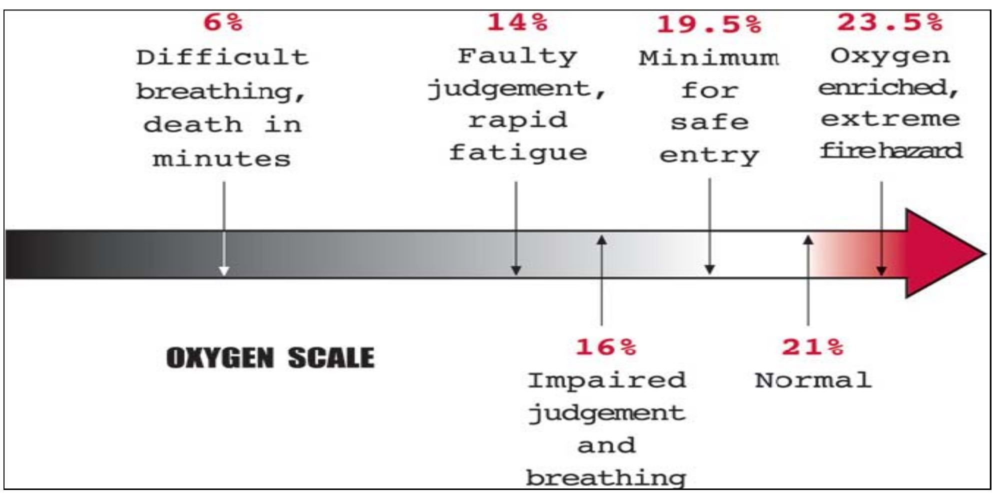
- Substances with a wide flammable range are considered to be more hazardous since they are readily ignitable over a wider range. However, *any* concentration of combustible gas or vapor should be of serious concern in a confined space.

### ▪ Why must atmospheric testing of confined spaces follow a certain order?

1. Oxygen is tested first because most combustible gas and toxic atmosphere meters are oxygen-dependent and will not provide reliable readings when used in oxygen-deficient atmospheres. In addition, both oxygen-deficient and oxygen-enriched atmospheres are extremely hazardous to workers' health and safety.

2. Combustible gases and vapors are tested next because the threat of fire and explosion is both more immediate and more life-threatening, in most cases, than exposure to toxic gases and vapors.

3. Toxic atmospheres are tested last. Many modern direct-reading instruments provide simultaneous readings of multiple gases.




## William "Bill" Bishop is Retiring

Bill Bishop will retire January 13, 2008 after 17 years working in Emergency Management. Bill's last four years were as the Director of the Idaho Bureau of Homeland Security.

Bill was instrumental in forming the department in 2003 that merged the Idaho Bureau of Hazardous Materials with the Idaho Bureau of Disaster Services.

Bill also served in several capacities with the Federal Bureau of Land Management as a firefighter; a planning, training and exercise officer; a public affairs officer; and the director of the Idaho Bureau of Hazardous Materials. He taught a wide variety of emergency management and response sources and served on a number of committees including a group that shaped the Montana Disaster and Emergency Service reorganization and a task force that developed legislation for Montana's hazmat regional response teams.

EPA Region 10's Emergency Response Unit thanks him for his leadership and wishes him well in his future endeavors. Bishop's replacement as the director of Idaho BHS will be Colonel Bill Shawver. Colonel Shawver is currently the chief of staff of the Idaho National Guard Joint Force Headquarters where he has served for 32 years.

**Honored with a Life Time Achievement in Emergency Prevention Award**

## Idell Hansen Retires

Idell Hansen is retiring after 18 years with the Washington State Department of Ecology's Community Right to Know Program. The Environmental Protection Agency Region 10's Emergency Response Unit has honored Idell with a Life Time Achievement in Emergency Prevention Award for her contributions in the implementing the Emergency Planning and Community Right to Know Act (EPCRA).

Idell helped develop the Data DX system which allows electronic Tier II data (i.e., annual chemical inventories) to be provided directly to the LEPC's and Fire Departments that need it for community planning and emergency response. This data transfer supports the use of Computer-Aided Management of Emergency Operations (CAMEO), a software program developed jointly by NOAA and the EPA, which is frequently used by the Fire Departments to model and map chemical releases. Idell educated the regulated public on Tier II and Toxic Release Inventory (TRI) reporting through her contributions in EPCRA workshops, Washington's EPCRA Hotline and the development of the TRI Display System (TRIDs) that allows the data to be viewed.

EPA Region 10 would like to thank Idell Hansen for her contributions in the area of Emergency Preparedness and congratulate her on her December 14, 2007 retirement. We welcome Diane Fowler to our staff to continue Idell's excellent work.

**EPA's Office of Emergency Management is launching a new, redesigned web site** at www.epa.gov/emergencies to improve the experience for everyone looking for information about EPA's prevention, preparedness and response programs. Our goal is to ensure that the web site continues to provide relevant, up to date, and accessible information to all of our users. The new site is easier to navigate and find information. To help users who may have bookmarked specific pages, we have developed topical error pages for the different programs. These pages provide a list of links that will redirect users looking for specific information to a page on the new site that has the information on that topic.